

# Non-marine Ostracod biogeographical regions of the early Cretaceous in China

By

YE CHUN-HUI\*)

With 1 text figure

## ABSTRACT

The investigations of the non-marine ostracods of the early Cretaceous in China (predominantly representatives of the superfamily Cypridacea) permit a subdivision into two large paleobiogeographical regions, each of which can be divided again into three subregions. The assemblages of these regions are characterized. In addition to numerous endemic forms the

fauna in the province of North China can be related to those of Central Siberian region and Mongolia. The province of South China reveals interconnexions with the Centralasiatic-Southern Russian province. A warm, subtropical climate is suggested for both provinces.

## KURZFASSUNG

Die Untersuchungen der nicht marinen Ostrakoden der Unterkreide in China (meistens Vertreter der Überfamilie Cypridacea) gestatten eine Einteilung in 2 große paläobiogeographische Regionen in denen jeweils wieder 3 Unterregionen ausgeschieden werden. Die Vergesellschaftungen dieser Unterzonen werden charakterisiert. Neben vielen ende-

mischen Formen zeigen die Faunen in der nordchinesischen Provinz Beziehungen zur mittel-sibirischen Region und zur Mongolei, während die südchinesische Provinz Gemeinsamkeiten mit der mittelasiatischen-südrussischen Provinz aufweist. Für beide wird ein warmes, subtropisches Klima diskutiert.

## I. EARLY CRETACEOUS NON MARINE OSTRACOD ASSEMBLAGE AND BIOGEOGRAPHICAL REGIONS IN CHINA

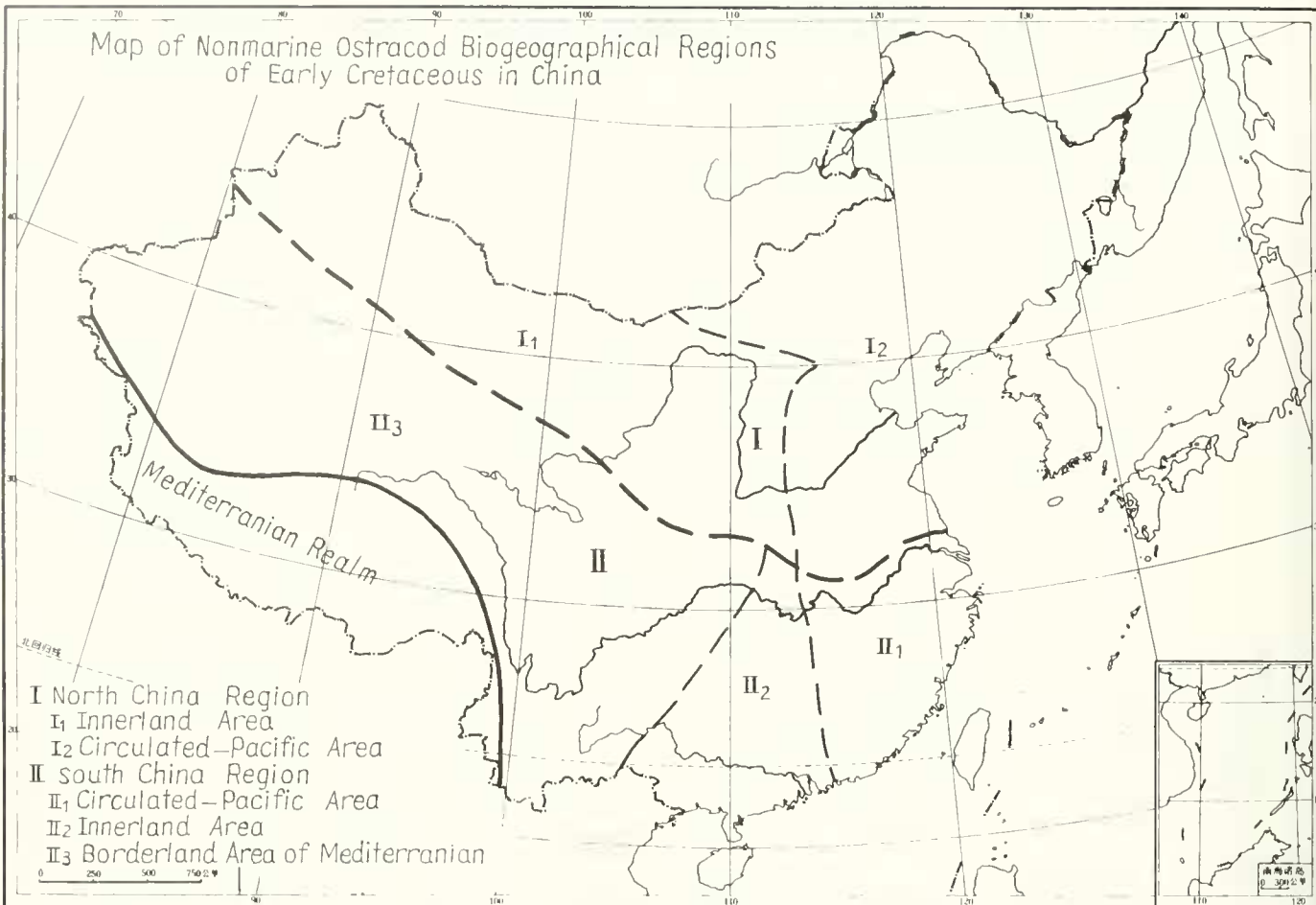
Between the late Jurassic and late Cretaceous, there were about 30 genera and 350 species of non-marine ostracodes in continental sediments over most of the territory of China. Most of them fall into superfamily Cypridacea except a few which are involved in superfamily Cytheracea. The early Cretaceous non-marine ostracod fauna is widely distributed in two different biogeographical regions: The North China and The South China regions, with the Mts. Tianshan, Qilian, Qinling, Wuniu and Dabei as their borderland. In geography the former includes North-Eastern China, Northern China, Shandong, Shanxi, Shaanxi, Inner Mongolia, Ningxia, Gansu, Zhungeer Basin of Xinjiang and the north of Jiangsu, Anhui. The latter covers South-Central and South-Eastern Chi-

na, Tarim Basin of Xinjiang, Qinghai, Zhejiang, the south of Anhui and Jiangsu.

The North China region is characterized by the high diversity of complex-ornamented *Cypridea* and the presence of genera *Mongolianella*, *Luanpingella*, *Zonocypris* and *Candona* throughout the early Cretaceous and it may be separated into the Innerland Area (I<sub>1</sub>) and the Circulated-Pacific Area (I<sub>2</sub>).

The South China region differs from the North China region in the appearance of *Jingguella*, *Monosulcocypris* and *Pinnocypridea*; the genus *Cypridea* in this region carries simple ornaments. Based on the endemic species, it may be divided into the Borderland area of Mediterranean (II<sub>3</sub>), the Innerland area (II<sub>2</sub>) and the Circulated-Pacific area (II<sub>1</sub>). (see fig. 1).

\*) YE CHUN-HUI, Institute of Geology and Palaeontology, Academia Sinica, Chi-Ming-Ssu, Nanjing, China.



A. The early Cretaceous non-marine ostracodes of the South China region can be separated into three ostracod assemblages:

1. *Jingguella-Pinnocypridea-Darwinula* assemblage of early Cretaceous;
2. *Cypridea-Mongolianella-Darwinula* assemblage of middle early Cretaceous;
3. *Cypridea (Morinia) - C. (Bisulco) - Monosulco-cypris* assemblage of late early Cretaceous.

1. The *Jingguella-Pinnocypridea-Darwinula* assemblage is characterized by the appearance of great number of *Jingguella* including many subgenera, such as *Jingguella (Jingguella)*, *J. (Minheella)*, *J. (Jiangenia)* and a number of *Darwinula*, *Damonella*, *Pinnocypridea* and *Cypridea* which are in possession of faint beak and notch. The age of the ostracod assemblage is supposed to be early early Cretaceous, corresponding to the Berriasian of Western Europe, and also probably late Portlandian.

The Chengqiangyan Group of Sichuan within the Borderland area of Mediterranean of the South China region is a typical bed that contains the first ostracod assemblage. The other formation containing this ostracod fauna is the lower part of Qiapushaliang formation of Tarim Basin, Xianjiang; the Datonghe formation of Minhe Basin, Qinghai; the Jinxing formation of Lanping-Simaoo district and the Gaofengshi formation of Chuxiong district, Yunnan. With the exception of these, there are individual elements of the first ostracod assemblage to be found in the Yuantang formation of Southern

Anhui and its equivalent continental deposits in Central Asia, USSR.

2. The *Cypridea-Mongolianella-Darwinula* assemblage is the middle early Cretaceous ostracod fauna of the South China region. Among the main characters of this ostracod assemblage are the simple ornaments of *Cypridea* and a moderate number of *Darwinula*, *Rhinocypris*, *Zizophocypris* and *Damonella*. Of great significance determining the age of this ostracod assemblage is the frequent appearance of *Cypridea (Ullwellia) paulsgrovensis* ANDERSON, *C. (U.) minevensis* ANDERSON which are the important members of ostracod assemblages of Wadhurst Clay (middle Valanginian) in England. According to the data above, this ostracod assemblage is referred to middle early Cretaceous in age and it is considered to be equivalent to Valanginian to Barremian in Western Europe.

Most typical strata that contain the second ostracod assemblage is the Puchanghe formation of Yunnan. The other formations that contain individual elements of them are the Gudian formation of Sichuan; the lower subgroup of Hekou Group of Minhe Basin, Qinghai and the upper part of Shouchang formation from Zhejiang. The first and the second ostracod assemblages have not been discovered so far in the Innerland area of the South China region.

3. *Cypridea (Morinia) - C. (Bisulco) - Monosulco-cypris* assemblage is the late early Cretaceous ostracod fauna in the South China region which is characterized by *Cypridea (Morinia)* associated with *Cypridea (Bisulco)* which

is the common member of late early Cretaceous (Aptian to Albian) non-marine ostracods all over the country. In addition, there is higher development of small carapace forms of *Darwinula* and of genus *MonosulcoCypris* which is widely distributed in the red beds of the South China region.

The widespread late early Cretaceous ostracod assemblage can be compared with each other in the South China region where the endemic species came into existence especially in the Innerland area (II).

The strata containing this ostracod assemblage are the Matoushan formation and Mangang formation of Yunnan; the upper subgroup of Hekou group, Minhe Basin of Qinghai; the Qijiahe formation and Dongjing formation of Hunan; Ningxiang formation of Hubei; Huizhou formation of Southern Anhui; Huoko formation of Fujian and Guantou formation of Zhejiang.

It is worth mentioning that an important ostracod assemblage which is characterized by *Cypridea* (*Morinia*) associated with *MonosulcoCypris* is usually present in the lower part of some strata, such as the lower part of Huizhou formation and the Hengshan formation.

B. The early Cretaceous non-marine ostracodes of the North China region can also be divided into three ostracod assemblages:

1. *Cypridea-Luanpingella-Eoparacypris* assemblage;
2. *Cypridea-Yumenia-Mongolianella* assemblage;
3. *Cypridea*-“*Lycocypris*”-*Mongolocypis* assemblage.

1. The *Cypridea-Luanpingella-Eoparacypris* assemblage contains a poor number of *Cypridea* which has complex ornaments and only a few kinds of *Cypridea* (*Cypridea*) and *C.* (*Cyamocypris*) are present. In addition, genus *Luanpingella* is an important member in this ostracod assemblage.

The Dabeigou formation of Northern Hebei and the Chejinpu formation of Ganxu are of typical *Cypridea-Luanpingella-Eoparacypris* ostracod assemblage. The ostracod faunas of the other equivalent strata in the North China region are more or less distinct from them.

It is particularly significant that *Eoparacypris jingshanensis* YANG and *Cypridea sulcata* MANDELSTAM of the Dabeigou formation are very similar to *Eoparacypris macroselina* ANDERSON and *Cypridea bimammata* (HARBORT) in the Berriasian stage of Southern England. For this reason, it is justifiable to say that the *Cypridea-Eoparacypris-Luanpingella* assem-

blage is the earliest non-marine ostracod fauna of the Cretaceous in the North China region and is considered to be contemporaneous with the first ostracod assemblage of the South China region.

2. Unlike the first ostracod assemblage of early Cretaceous the *Cypridea-Yumenia-Mongolianella* assemblage is characterized by the high diversity of forms and the complex-ornamentations in *Cypridea*. In addition to *Cypridea* (*Cypridea*), there are *Cypridea* (*Morinia*), *C.* (*Ullwellia*), *C.* (*Cyamocypris*), *C.* (*BisulcoCypridea*) and *Yumenia* (including to *Cypridea* (*Yumenia*) before). The Diwopu formation or Xiagou formation of Ganxu is a typical bed in the North China region which has a lot of such ostracod faunas. The other equivalent formations of the North China region are the Jiufutang formation of Western Liaoning, the Guyan formation of Inner Mongolia, the upper part of the Zhidan group of Ertoushi has the some ostracod fauna but the individual elements of them may be absent in some formations.

It should be noted that some species of *Cypridea* in the second ostracod assemblage are similar to those of England, i. e. *Cypridea koskulensis* resembles *Cypridea bogdensis*, *Cypridea setina gansuensis* YE is similar to *Cypridea setina* ANDERSON, *Cypridea changmaensis* YE is similar to *Cypridea dolobrata angulata* MARTIN, *Cypridea* (*BisulcoCypridea*) *subchuxiongensis* YE to *Cypridea* (*BisulcoCypridea*) *frithwaldi* ANDERSON. All of these English species of *Cypridea* occur in Valanginian to Barremian stage of Lower Cretaceous. On this base, the second ostracod assemblage should be referred to the middle early Cretaceous in age and may be equivalent to the Valanginian to Barremian stages of Western Europe.

3. The *Cypridea*-“*Lycocypris*”-*Mongolocypis* assemblage is the late early Cretaceous fauna in the North China region. The character of this ostracod assemblage is allied to the third ostracod assemblage of the South China region in the appearance of *Cypridea* (*Morinia*) associated with *Cypridea* (*BisulcoCypridea*). However because of the presence of *Zonocypris*, *Candona* and a great number of *Mongolocypis*, it may be able to differentiate from the South China region.

The strata containing the third ostracod assemblage are the Zhonggou formation of Gansu, the upper part of Liupanshan group, Ningxia; the upper part of Qingshan formation, Shandong; Sunjiawan formation of western Liaoning; the lower part of Songhuajiang group, Songliao Plain and Dalaji formation and Tongfushi formation of Yianjia district, Jiling.

## II. PROBLEMS AND DISCUSSION

1. The early and middle early Cretaceous non-marine ostracod fauna of the North China region is similar to the ostracod assemblages of Mongolia, the East Asian region and the Middle Siberian region of USSR and the Circum-polar belt of Europe (ANDERSON, 1973), that means the North Circum-Polar Province.

The non-marine ostracod fauna of the South China region resembles the ostracod fauna of Middle Asian region of USSR. Both remain to have Asian endemic character. It seems that the South China region of China and the Middle-Asian

region of USSR are of the same ostracod biogeographical province which is the transition between the North Circum-Polar Province and the South Circum-Polar Province.

During the late early Cretaceous, the ostracod assemblages of both regions has their own endemic species, but the resemblance between the North China region and the South China region as shown in *Cypridea* (*Morinia*) associated with *Cypridea* (*BisulcoCypridea*) is an important character which is commonly seen from Lebanon, Turkman of USSR, the USA, England and Congo, that is the North and the South of the

circum-polar belt (ANDERSON, 1973). For this reason, it cannot be stated with certainty whether the endemic species of both regions at this age are characteristic enough to separate China into the North China region and the South China region or whether the whole China belongs to only one ostracod biogeographical region.

2. The border line between the North China region and the South China region should be designated the direction of paleo-latitude. If this assumption is correct the North-polar of Cretaceous would be situated in the area Eastward to the present North-polar, while the South-polar would be at the west to the present South-polar.

3. The distribution of early Cretaceous non-marine ostracod fauna may be connected with the temperature-climatic zones. During the early and middle early Cretaceous, the North China region was connected with the Northern circum-polar belt (ANDERSON, 1973). It is situated in the same paleo-latitude and has a high diversity of complex-ornamented *Cypridea*. ANDERSON (1973) stated that the climate of the *Cypridea* belt was similar to that which is now found in the Southern Mediterranean-North African area and it was a nearly sub-tropical climate. According to the development of light-colour deposits and of coalbearing beds and in addition to the palynological data, we suggest that the North China re-

gion may be of nearly sub-tropical character, as ANDERSON thought to be, with more or less wet climate.

During the early early Cretaceous red beds dominated all over most of the South China region. The ostracod fauna of this region bears the character of Asia-endemic species. Some of them occur recently in South Africa and Southern Brazil. On the other hand, the genus *Cypridea* is not so frequent in this region and carries simple ornamentation. All of this seem to show that it is nearly sub-tropical with dry and hot climate.

In middle early Cretaceous of the same region, there are many light-colour deposits alternating with red beds and the ostracod fauna of the South China region has some Asian endemic species, but some species of *Cypridea* are similar to those in England. On the basis of selected data discussed above, the climate of the South China region at this time may be sub-tropical, alternating dry with wet climate.

During the late early Cretaceous, it is not known whether both of the North China and the South China regions may belong to northern circum-polar belt of ANDERSON (1973) or not. The presence of widespread red beds and of the genus *Zonocypris* which is a living genus of Africa may indicate that the climate of both regions was hotter and drier i. e., nearly a sub-tropical climate.

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